

IX. *The Scent-scale of Pinacopteryx liliana Gr. Smith.*  
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PLATE XVI.

IN a recent communication on the *charina* group of *Pinacopteryx*,\* mention was made of the remarkable scent-scale of *P. liliana* Gr. Smith, ♂. It is now proposed to give a fuller account of this structure, so far as its details can be made out in the absence of fresh material.

As has been elsewhere recorded,† the outline of the lamina of this scale, when seen on the flat, resembles that of the thin glass flasks used in chemical laboratories (Pl. XVI, fig. 1). At the junction of the neck with the body of the flask there is a round or oval granular area (*a*), which under moderate powers of the microscope appears dark by transmitted light, and usually shows a comparatively transparent, highly refracting, roughly circular patch in the middle. The proximal part of the lamina is marked by a fine longitudinal ribbing, which loses distinctness as the central granular area is reached. Examined with a  $\frac{1}{12}$ -inch immersion lens, each rib in the proximal dilated portion of the lamina has a varicose appearance, as if consisting of a row of very fine granules; these rows can be traced with some difficulty through the central area. Beyond the central area, and throughout the distal portion or neck of the lamina, the ribs are still visible, now parallel with each other and closer together; in this situation the ribs are finer and the varicose appearance is less marked. In the region of the central area, numerous additional granules come into view; these are somewhat larger than the rib-granules and are irregularly disposed. Their presence tends to obscure the regular ribbing of the scale; this, however, probably persists throughout the central area, being continuous in fact from base to apex

\* Trans. Ent. Soc. Lond., 1918, p. 191.

† Proc. Ent. Soc. Lond., 1912, p. cx, Pl. E, fig. 10.

of the lamina. If the scale be stained with a solution of coal-tar "light green" in alcohol and examined dry, the varicose ribs are shown with greater distinctness, and the central area is seen to contain a homogeneous body staining deeply with the reagent; this body, hereinafter referred to as the "central substance," corresponds with the highly-refracting patch visible in the unstained scale. The granules of the central area appear to be unstained; but the presence of the granules, and especially the deep coloration of the central substance, interferes with the tracing of the ribs in their course through the central area. If the stained scale be mounted in Canada balsam, it becomes so transparent that over the greater part of the lamina the ribbing can only be made out with difficulty. The central substance, however, is very clearly defined; and in its neighbourhood the ribbing and granules are fairly distinct.

Further light upon the relation of the central substance to the general structure of the scale is afforded by some sections prepared with great skill by my friend Dr. H. Eltringham. Sections taken longitudinally through the fore-wing in a male specimen of *P. liliana*, stained with light green and safranin and mounted in Canada balsam, show the wing-membrane stained a deep pink, with sockets on both upper and lower surface for the reception of the footstalks of the scales (Pl. XVI, fig. 2). Sockets of the ordinary character occur on both surfaces; but on the upper surface, in addition to these, there are visible the special sockets for the reception of the basal portion of the scent-scales; further reference to these special sockets and the articulating structure of the scale will be made later.\* Many of the scent-scales are shown in section; sometimes the whole length of the scale is visible, from the portion engaged in the socket to the tuft of fimbriae at the distal extremity (Pl. XVI, fig. 3). In these cases the scale itself exhibits a pink staining, generally paler than that of the wing-membrane; while the central substance (*c*) is distinctly defined and stained blue, this colour being apparently the result of the combined action of the two staining reagents. The lamina of the scale (*d*) is for the most part extremely thin, but in the region of the central substance the upper and lower layers (*a* and *b*) separate

\* See p. 387, *infra*.

from each other, giving rise to a cavity in which the central substance is seen in section as an oval or fusiform body in contact with the upper layer, a clear space being left between the central substance and the lower layer of the scale. The body itself tapers off distally and proximally, and frequently shows clefts in its substance which have no visible relation with any structural feature. In the neighbourhood of each of its thinned or pointed extremities there is an appearance as of a small accumulation of granules which seem not to share in the blue staining. These no doubt are the "granules" which were noted as visible in the scale mounted in balsam and observed on the flat, but it may be doubted whether they are due to anything more than irregularities of the surface of the lamina.

Transverse sections under similar treatment show corresponding appearances. In those sections that have passed transversely through the central substance, the clear interval between this substance and the lower layer of the scale is readily seen; the substance itself is fusiform in outline, and a similar or more marked appearance of unstained "granules" occurs at each extremity. A faint beading on the upper layer in the region of the central substance indicates the delicate ribs seen when the scale is examined on the flat. Both beading and "granules" are probably the ridges or ribs of the upper surface of the scale in cross section. In a few cases the under surface of the cavity containing the central substance appears in transverse section to be slightly beaded. The nature of the central substance is uncertain, but the appearance it presents both in the stained and unstained condition is consonant with Dr. Eltringham's suggestion that it represents an accumulation of dried secretion.

In scales that have been doubly stained in light green and safranin and mounted in Canada balsam, the footstalk and accessory disc are coloured pink, whereas the central body, as before noted, is stained blue or greenish blue. The latter colour is also generally to be found at the central region of the base of the lamina, this being the part which marks the insertion of the footstalk.

When the scale is examined on the flat, with the lower surface uppermost, the accessory disc is usually seen to be superposed upon the lamina, the footstalk being so curved as to bring it into this position. If the upper

TRANS. ENT. SOC. LOND. 1919.—PARTS III, IV. (DEC.) C C

surface is above, the condition is of course reversed, and the accessory disc is seen through the superposed lamina. In either case, the termination of the footstalk in the disc is quite abrupt, and is in apparent connection with a peculiar area of the disc, oval in outline and surrounded by a chitinous ring which seems to be beaded. This, as will be seen later, is probably an aperture. The distal end of the footstalk, at its junction with the lamina, is laterally expanded, becoming trumpet-shaped in outline. A longitudinal section shows that the lamina, footstalk and disc form an S-shaped curve; the footstalk being directed upwards from its origin in the disc, bending sharply over the upper margin of the disc, and then turning downwards to reach the point where it passes into the lamina (Pl. XVI, fig. 1, *c*; fig. 4, *e*, *a*, *b*). Here again there is a sharp bend (fig. 4, *b*), the lamina itself being parallel with this distal portion of the footstalk.

Some of the appearances presented by lamina, footstalk and disc are not easily interpreted; I think, however, that there is little doubt that the footstalk really arises from that surface of the disc which lies next to the wing membrane; that surface, consequently, which in the normal position of the parts is furthest from the lamina. What the relation may be between the origin of the footstalk and the chitinous oval ring mentioned above is doubtful; I am strongly inclined, however, to think that while the footstalk arises from what may be called the ventral surface of the disc, *i. e.* the surface which lies next to the wing-membrane, the chitinous ring bounds an aperture belonging to the other, or dorsal surface. In *Ganoris rapae* Linn., the footstalk has a marginal origin from the disc; and a notch or aperture is visible, indenting the margin at a point opposite to the origin of the footstalk.\* If the disc of *P. liliana* really possesses an aperture homologous with the aperture or notch in *G. rapae*, we must suppose that the disc in the former case is flattened at right angles to the plane of the disc in the latter. With respect to the interpretation of these appearances, it may further be noted that in many Pierine genera, *e. g.* *Nepheronia*, *Pieris* and *Appias*, the accessory disc can frequently be seen to carry an indentation similar to that in *G. rapae*, and like that feature, suggesting a proximal aperture.

\* See Proc. Ent. Soc. Lond., 1909, Pl. D, fig. 4.

When the wing-membrane of *P. liliana* has been denuded of scales, three kinds of socket for the reception of the footstalks of the scales come into view. Those for the ordinary scales are simple funnel-shaped structures, arranged for the most part in parallel rows nearly at right angles with the axis of the wing, and differing in aspect according to whether they belong to the upper or lower surface; those of the former being more amply surrounded by chitinous folds of the membrane, and so presenting a darker appearance. In addition to the ordinary sockets on the upper surface may also be seen the sockets of the scent-scales. These likewise run in parallel rows, between the rows of ordinary sockets. They are fewer in number than the latter structures, and easily to be distinguished from them; being larger in size, broader in shape and darker in aspect (Pl. XVI, fig. 5, *a*, *b*, *c*). Each terminates distally in a transparent crescentic chitinous lip, which is fringed with a row of spiny projections radiating from its convex margin. Proximally to the fringed lip the socket shows a dark opaque area, roughly oval or circular, which shades off into the general surface of the wing-membrane by a number of striations, parallel with the long axis of the socket, and apparently constituted by chitinous folds. In longitudinal sections of the wing-membrane, the funnel-shaped contour of the ordinary sockets of both upper and lower surface is clearly seen; it can also be recognised that the former are set at a somewhat steeper angle to the membrane than the latter, which are more nearly in the plane of the wing (Pl. XVI, fig. 2, *b*, *c*). The sockets of the scent-scales are again easily distinguishable by their larger size and the projecting lip, which is now seen in profile (fig. 2, *d*). A similar lip is visible on the side of the socket which abuts on the wing-membrane; the latter, however, projects from the main body of the socket to a much smaller extent than the former; it also appears to be devoid of the marginal row of spines. These lips may be called "upper" and "lower" respectively; together they form a rim which appears to be continuous round the mouth of the socket.

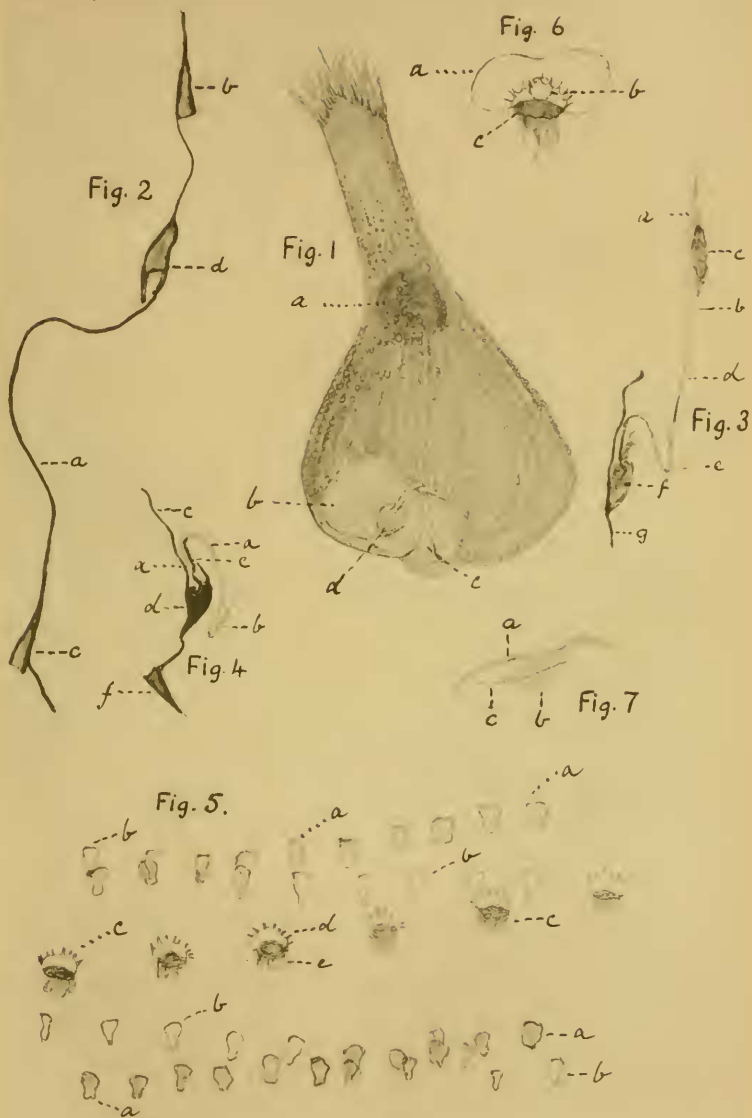
In a partially denuded wing examined on the flat, the accessory disc of each scent-scale is seen to be engaged in its appropriate socket (Pl. XVI, fig. 6). The disc is much larger than its receptacle, and the only part that is actually included within that structure is a semicircular



or segmental area occupying the middle of the proximal edge of the disc. When seen in longitudinal section, the disc appears to fit into a groove between the upper and lower lip of the socket; its proximal margin being curled over towards the lower lip, in contact with the main substance of the socket. In a fortunate section the footstalk may be seen to wind over the distal edge of the disc, and to lie in close juxtaposition with its lower surface (Pl. XVI, fig. 4). Before reaching the curled-over part of the disc it disappears, having apparently become fused with the disc about midway between the proximal and distal edges. I have never succeeded in identifying any appearance in these longitudinal sections as due to the aperture. In transverse sections, the ordinary sockets appear simply as chitinous rings, each enclosing a circular or oval lumen. The sockets of the scent-scales, besides being much larger, are distinguishable by the fact that they show a central body oval in outline and staining readily, in place of the orifice visible in the ordinary sockets. This central body is surrounded by a less deeply stained zone, also oval in outline, and somewhat irregular if the section has happened to pass through the socket near its insertion in the wing-membrane. In many of the sections the disc is seen as a beaded line crossing the socket in the direction of the long axis of the latter, and projecting for a considerable distance at each end (Pl. XVI, fig. 7). I have never been able to satisfy myself that the footstalk is recognisable in these transverse sections.

It is probable that the examination of material properly treated while fresh would clear up many points which are obscure in the dry condition. I am hoping that it may be possible to obtain in course of time some specimens of *P. liliana* which have been put at once into preservative reagents. Meanwhile the facts at present observed seem to be sufficiently interesting to be placed on record in this brief communication.

I am greatly indebted to my friend Dr. H. Eltringham for the care and skill which he has employed in making the sections described and figured in the present paper.



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